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LEGEND

= state/response variable

= environmental input

= global/universal parameter

= taxon specific parameter

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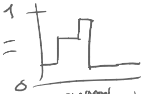
CONSUMER

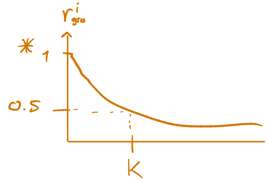
$f^{i}_{current} =$ 

↳ presented first as a matrix
e.g.
then with another score pref. assignment (see PV paper)

$$
\begin{array}{c|ccc}
 & \multicolumn{3}{c}{\text{current cat.}} \\
\hline
\text{(group of) taxa} & \alpha & \beta & \gamma \\
 & \alpha & \alpha & \beta \\
 & \alpha & \gamma & \gamma
\end{array}
$$

α, β, γ pref. scores parameters not updated

if env. cond. are bad growth is limited
factors calculated before with input env. cond.



pref. on env. cond.

half-saturation density of biomass regarding self-inhibition

$$h_{dens}\, f_{current\,i}\, f_{temp\,i}\, f_{substrate\,i}$$

sum of surface densities of all food sources

$q \in \{1,2\}$

$$\frac{\left(\sum_{m<i} D_m\right)^q}{K_{food\,i} + \left(\sum_{m<i} D_m\right)^q}$$

$$\frac{p_j D_j}{\sum_{m<i} p_m D_m}$$

$$f_{mort}\, f_{orgcontam\,i}\, f_{saproby\,i}$$

$$\frac{K_{dens\,i}}{K_{dens\,i} + D_i}\ ^{*} \quad \text{or} \quad \begin{cases} 1 - \dfrac{D_i}{2K_{dens\,i}} & D < 2K_{dens} \\ 0 & D \geq 2K_{dens} \end{cases}$$

$$D_i\, i_0\, \frac{M_i^{b-1}}{M_0^{b}}\, e^{-\frac{E}{kT}}\, \frac{1}{EC_i}$$

$$\frac{\partial B_i^{cons}}{\partial t} = \underbrace{\left(\sum_{j<i} f_{gro}\, f_{grotax\,i}\, f_{limfood\,i}\, f_{pref\,ij}\, f_{selfinh\,i} - f_{resp} - f_{mort} \right) f_{basaltax\,i}\, r_{basalmetab\,i}}_{\text{growth, respiration and mortality of species i feeding on j}}$$

stream width

$$- \underbrace{\left(\sum_{k>i} \frac{1}{Y_{gro\,k}}\, f_{gro}\, f_{grotax\,k}\, f_{limfood\,k}\, f_{pref\,ki}\, f_{selfinh\,k}\, f_{basaltax\,k}\, r_{basalmetab\,k} \right)}_{\text{predation of species k on species i}} w$$

$$\min\left(1, \frac{EC_i - f_e EC_{FPOM}}{EC_k}, \frac{\alpha_{N_i} - f_e\, \alpha_{NFPOM}}{\alpha_{Nk}}, \frac{\alpha_{P_i} - f_e\, \alpha_{PFPOM}}{\alpha_{Pk}}\right)$$

(green) = state variables, (pink) = env. conditions preferences, (blue) = universal (species independant)

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EQUATIONS FOR CONSUMER

half-saturation density of biomass regarding self-inhibition (at optimal habitat conditions)

$$h_{dens}\, f_{current\,i}\, f_{temp\,i}\, f_{substrate\,i}$$

limitation factors calculated with taxon preference/tolerance (habitat suitability functions) and env. inputs (see slide lim. factors)

$$f_{mort}\, f_{orgcontam\,i}\, f_{saproby\,i}$$

$$\frac{\left(\sum_{m<i} D_m\right)^q}{K_{food\,i} + \left(\sum_{m<i} D_m\right)^q}$$

$$\frac{p_j D_j}{\sum_{m<i} p_m D_m}$$

$$\frac{K_{dens\,i}}{K_{dens\,i} + D_i} \quad \text{or} \quad \begin{cases} 1 - \dfrac{D_i}{2K_{dens\,i}} & D < 2K_{dens} \\ 0 & D \geq 2K_{dens} \end{cases}$$

$$D_i\, i_0\, \frac{M_i^{b-1}}{M_0^{b}}\, e^{-\frac{E}{kT}}\, \frac{1}{EC_i}$$

$$\frac{\partial B_i^{cons}}{\partial t} = \underbrace{\left(\sum_{j<i} f_{gro}\, f_{gro\,tax\,i}\, f_{lim\,food\,i}\, f_{pref\,ij}\, f_{self\,inh\,i} - f_{resp} - f_{mort} \right) f_{basal\,tax\,i}\, r_{basal\,metab\,i}}_{\text{growth, respiration and mortality of species } i \text{ feeding on } j}$$

stream width

$$- \underbrace{\left(\sum_{k>i} \frac{1}{Y_{gro\,k}}\, f_{gro}\, f_{gro\,tax\,k}\, f_{lim\,food\,k}\, f_{pref\,ki}\, f_{self\,inh\,k}\, f_{basal\,tax\,k}\, r_{basal\,metab\,k} \right)}_{\text{predation of species } k \text{ on species } i} W$$

$$\min\left(1,\ \frac{EC_i - f_e\, EC_{FPOM}}{EC_k},\ \frac{\alpha_{Ni} - f_e\, \alpha_{NFPOM}}{\alpha_{Nk}},\ \frac{\alpha_{Pi} - f_e\, \alpha_{PFPOM}}{\alpha_{Pk}}\right)$$

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BASAL METABOLIC RATE

$$r_{basal\ metab} = D \cdot i_0 \cdot \left(\frac{M}{M_0}\right)^b \cdot e^{-\frac{E}{k_B \cdot T}} \cdot \frac{1}{EC}$$

density

normalisation constant [W]

individual biomass

allometric scaling component

1g

make fraction non-dimensional

activation energy [eV]

Boltzmann's constant $8.61 \cdot 10^{-5}\ \frac{eV}{K}$

absolute temperature

! Mean temp. of env. right?

energy content $\left[\frac{J}{gDM}\right]$

=> the bigger, the slower all rates

=> the smaller, the faster all rates

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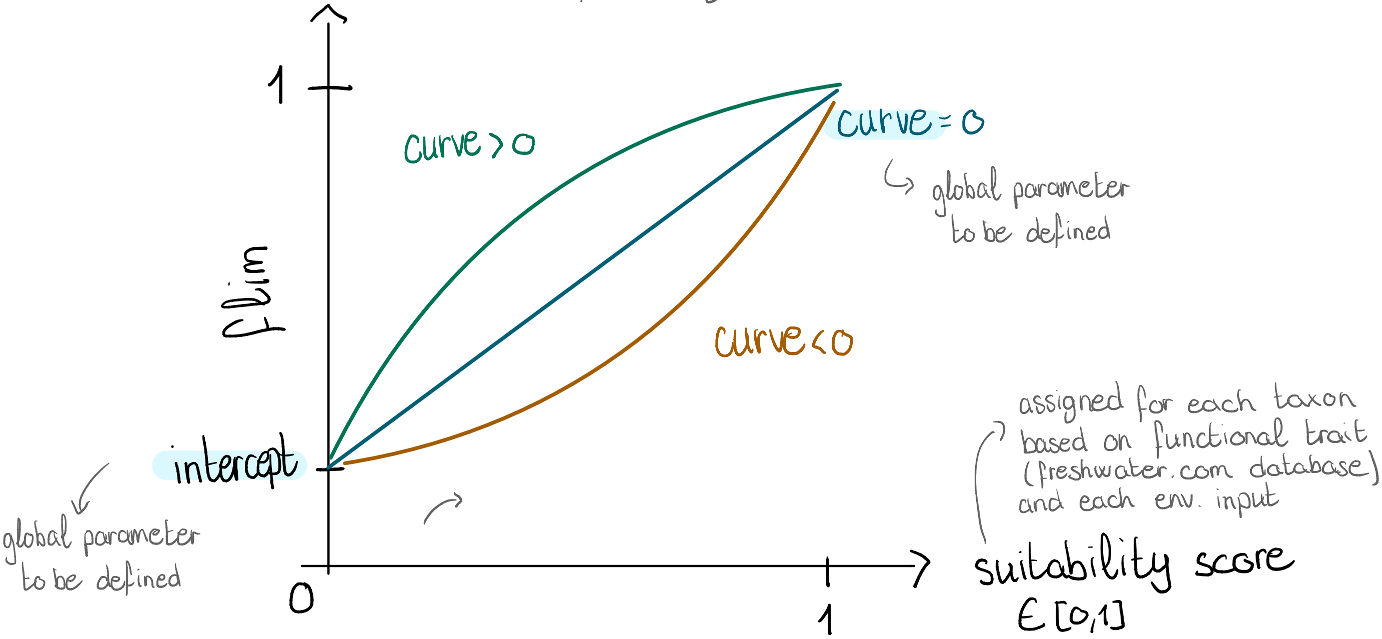
FUNCTIONS LIM FACTORS

$f_{lim} = f(\text{habitat suitability})$

1. for current, temp., microhabitat:
   multiplied together with h_{dens} to get half-saturation
   $\Rightarrow K_{dens} = h_{dens} \cdot f_{current} \cdot f_{temp} \cdot f_{microhabitat}$
2. for saproby: intercept > 1 and flim multiplied with fmort



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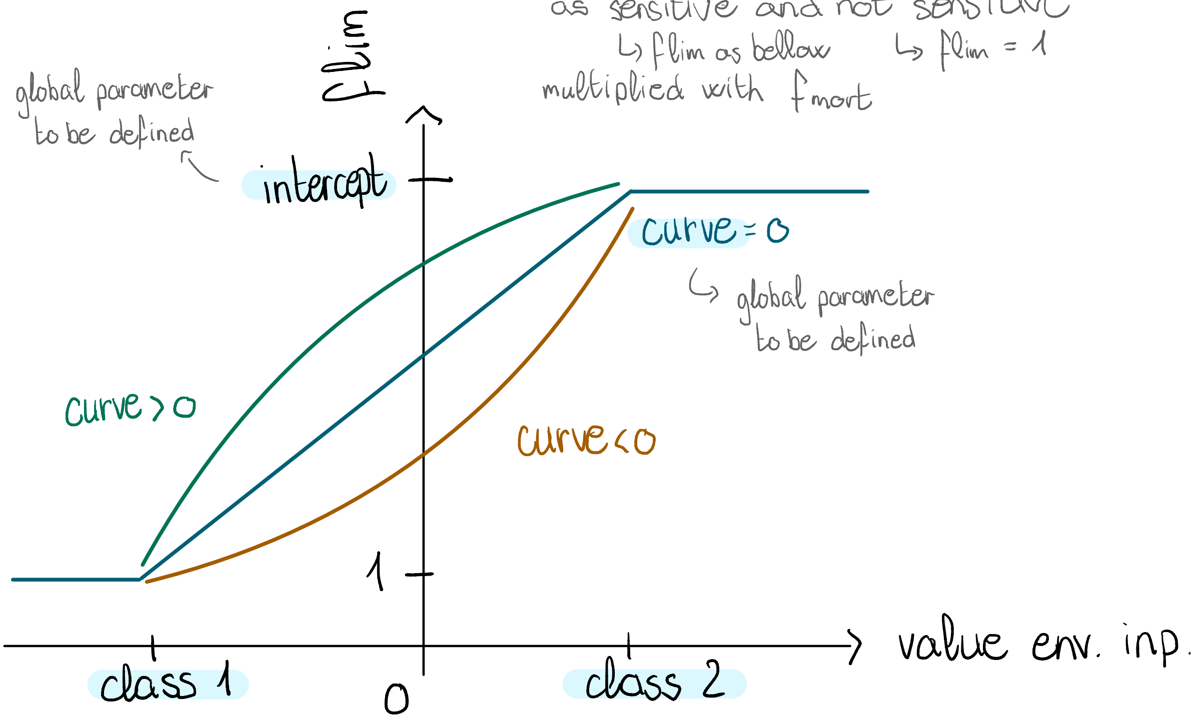
FUNCTIONS LIM FACTORS

$$f_{lim} = f(\text{env. input})$$

for organicmicro, taxa classified
as sensitive and not sensitive
↳ flim as bellow ↳ flim = 1
multiplied with fmort



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PERIPHYTON

I_0 = mean annual light intens. at the water surface (125 W/m²)

λ = light extinction coef. , $\lambda = 0.04 \cdot \underbrace{\tau}_{\text{mean turbidity}} + 0.73$

h = water depth

$$I = I_0 \cdot e^{-\lambda h}$$

self shading inhibitation factor

only k_{dens} for algae

fraction of the river shaded by trees

$$\frac{\partial B^{PP}}{\partial t} = \underbrace{\left(f_{gro} \, f_{grotax} \frac{I}{K_I + I} \, \min\left(\frac{C_P}{K_P + C_P}, \frac{C_N}{K_N + C_N}\right) \overbrace{\frac{K_{dens}}{K_{dens} + D}} \, (1 - f_{shade}) - f_{resp} - f_{mort} \right) f_{basaltax} \, r_{basalmetab} \, W}_{\text{growth, respiration and mortality of periphyton}}$$

stream width

⚠ needs to be corrected
has a too strong impact
on growth compared
to resp and death rates

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FPOM

so death process does not consume oxygen

$$\min\left(1, \frac{EC_{pp}}{EC_{FPOM}}, \frac{\alpha_{N\,pp}}{\alpha_{N\,FPOM}}, \frac{\alpha_{P\,pp}}{\alpha_{P\,FPOM}}, Y(v_{O_2}=0)\right)$$

$$\frac{\partial B^{FPOM}}{\partial t} = Y_{mort}\, f_{mort}\, f_{basaltax}\, r_{basalmetab\,pp}$$

$$+ \left(\sum_i \left(\sum_{j<i} \frac{f_e}{Y_{gro}}\, r^{cons}_{gro\,on\,j} + Y_{mort}\, r^{cons}_{mort} \right) f_{basaltax\,i}\, r_{basalmetab\,i} \right) w$$

FPOM excretion or sloppy feeding

stream width

= state variables, = env. conditions preferences, = universal (species independant)

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LITTER

fraction of riverbed shaded by trees

fraction of broad-leaved trees

direct input of leaf litter to a stream section fully covered by a broad-leaved canopy, assumed to be $500\,g\,\frac{DM}{m^2 yr}$ (Abelho 2001)

$$f_{shadebed}\, f_{broadleaf}\, Lit_{inp0}$$

$$Lit_{inp} = Lit_{bed} + Lit_{banks}$$

$0{,}3\ \frac{1}{m}$

distance from the edge of the canopy ??

$$2\, f_{shadebank}\, f_{broadleaf}\, \frac{1}{w} \int_0^{(1-f_{shadebed})w} Lit_{inp0} \cdot e^{-ks}\, ds$$

fraction of 10 m wide riparian zone covered by trees

Likelihood function

$$L(\theta, y) = \prod_{i,j,k} P_{i,j,k}(y_{i,j,k} \mid \theta)$$

taxon, site, sampling date

where
$$\begin{cases} P_{i,j,k}(y_{i,j,k}=0 \mid \theta) = P_{abs} + (1-P_{abs})(1-P_{obs})^{A_{j,k}\left(\frac{B^{ss}_{ij}(x_j,\theta)}{M_i} + n_{drift}\right)} \\ P_{i,j,k}(y_{i,j,k}=1 \mid \theta) = 1 - P_{i,j,k}(y_{i,j,k}=0 \mid \theta) \end{cases}$$

Close up on prob. to not observe a taxon

prob. that a taxon is abs. at sampling date k despite having a stable popul. at sampling site j (e.g. due to short term disturbance like floods)

$$(*)\quad P_{abs0}\, e^{-\frac{\log(2)\, B^{ss}_{ij}(x_j,\theta)}{K_{abs}\, M_i}}$$

steady-state solution of the model equ.

typical nb of indiv. per m² introduced by drift or misclassification

sampling area

mean indiv. biomass of taxon i

$$P_{i,j,k}(y_{i,j,k}=0 \mid \theta) = P_{abs} + (1-P_{abs})(1-P_{obs})^{A_{j,k}\left(\frac{B^{ss}_{ij}(x_j,\theta)}{M_i} + n_{drift}\right)}$$

(*)